Neuro-Fuzzy based inventory control system

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ABSTRACT

This poster presents an inventory control system which is based on Neuro-Fuzzy logic. The presented method is able to determine the optimal stock level and cost without knowing the exact mathematical model of the examined system.

Categories and Subject Descriptors

I.5.1 [**Computing Methodologies**]: Models – *Fuzzy set, Neural nets*

General Terms

Algorithms, Management, Economics, Theory, Verification.

Keywords

Inventory control, Neuro-Fuzzy, ANFIS

1. INTRODUCTION

The production and usage of a product differs in time and space so during the distribution of goods disorder may occur. To achieve a smooth supply chain process stock keeping is required.

It is necessary to keep the optimal value of the stock because of its financial outgo such as worth and stock keeping costs. This could be difficult as corporate processes are in most cases stochastic and inordinately complex.

This poster presents an inventory control system which is based on Neuro-Fuzzy logic. The presented method is able to determine the optimal stock level, cost without knowing the exact mathematical model of the examined system. The method is basically a decision support system (DES) and it is able to provide the order scheduling parameters of goods at operational level.

The aim of the current research is to demonstrate that a Neuro-Fuzzy based logic controller is capable to solve complex inventory problems and with future improvements it is able to achieve cover all important parameters of the controlled system.

This work is connected to the scientific program of the "Development of quality-oriented and harmonized R+D+I strategy and functional model at BME" project. This project is supported by the New Hungary Development Plan (Project ID: TÁMOP-4.2.1/B-09/1/KMR-2010-0002).

2. INVENTORY CONTROL

The function of an inventory control system is to fulfill the demand of the current (production, consumption) process, to operate inventory strategies and to keep the optimal stock level. Accordingly the control system can be divided into a stock monitoring, an inventory strategy and an order placing subsystem [1]. The controller is directly connected to the examined process and through order placing it influences the stock levels in various parts of the supply chain.

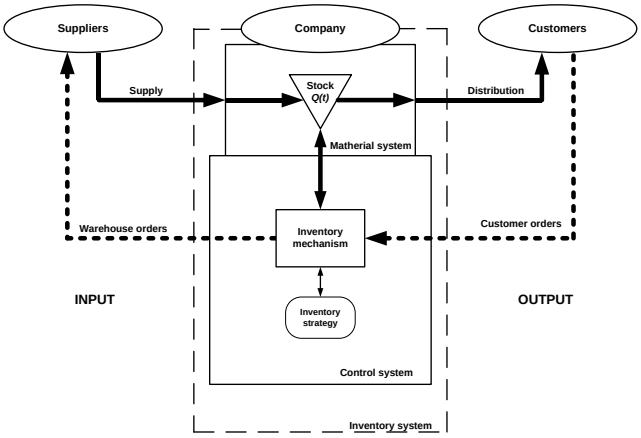

Figure 1. Inventory control system

3. THE ANFIS CONTROLLER

In the ANFIS controller the learning capable neural network (Figure 2.) is a SISO (Single Input – Single Output) system.

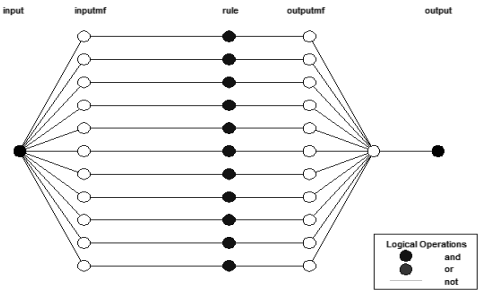

Figure 2.: The structure of the neural network

The input of the network is the expectation values of the demand. 11 Gauss-function based fuzzy sets (Figure 3.) are being created to cover the base set of the mean values, accordingly the rule set of the fuzzy system contains 11 "IF-THEN" rules.

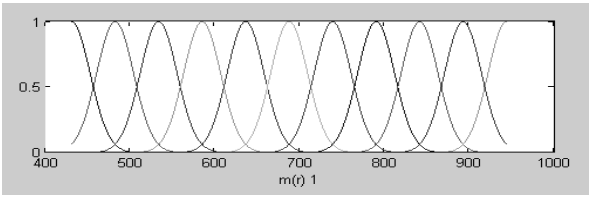

Figure 3.: Fuzzy sets

Earlier period demand data (Figure 4.) is being used by the neural network to learn fuzzy rules and fuzzy member functions.

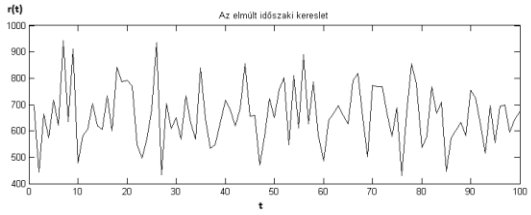

Figure 4.: Demand data from the past

With the aggregation of the results of the fuzzy rules the output of the network can be calculated, which is currently the optimal order quantity.
This order quantity is a minimum value of a cost function (Figure 5.) and describes a parameter set of the optimal values.

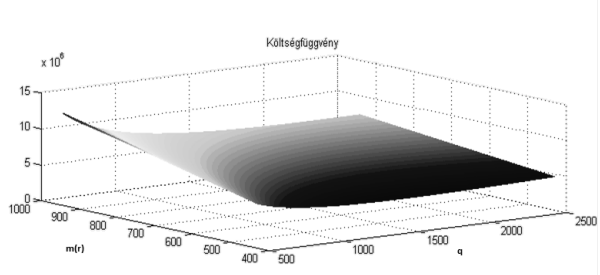

Figure 5.: Cost function

4. TEST SYSTEM

To create an inventory control system for testing purposes the MATLAB mathematical software was being used. The software provides fast application development as well as a powerful GUI builder.

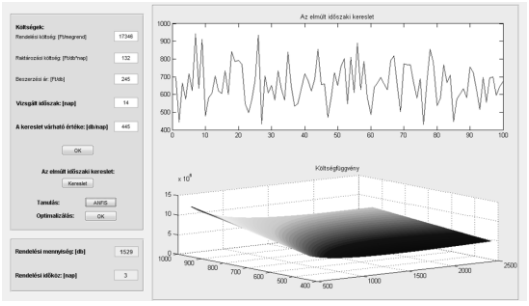

Figure 6.: User interface of the inventory control system

On the graphical user interface (Figure 6.) input data such as costs, examined period, expectation values of the demand in addition the earlier period demand data can be maintained. Excel spreadsheet is being used as input source, but an interface is being planned to connect the controller to an existing ERP.

After optimizing the results - such as optimal order quantity and interval - are being displayed on the screen. It is relevant to note that time series learning must be accomplished only once at the initialization phase.

5. RESULTS

To proof that an ANFIS based inventory control system can provide optimal solution testing is being needed. To do so earlier period demand data was being used characterized with normal distribution, different expectation values and variances. In some cases the costs were also been changed. In the current phase of the research the economic order quantity (EOQ) - a simple -inventory model has been being used.

In Table 1. the clustered expectation values of the earlier period demand data and variances are being shown. The third column of the table contains the difference between the predicted an expected values.

Table 1. Results

Expectation values	Variance	Difference [%]
200…500	10 %	0,0
500…800	10 %	0,0
500…800	20 %	0,0
800…1100	5 %	0,0
800…1100	10 %	0,0
800…1100	20 %	0,0
800…1100	30 %	0,0

The results clearly show that in all of the examined cases the controller provided the optimal value. Conclusively the ANFIS driven inventory control system is being labeled as usable for accomplishing the above defined simple inventory control tasks. It is being suspected that a more complex inventory problem can also be solved with this method. To prove this further investigation with increased complexity is being planned.

6. SUMMARY

One possible way to improve current inventory control system is the usage of artificial intelligence methods such as neural network, fuzzy system and genetic algorithm since a human-made decision support system (DSS) can behave similar way as an intelligent living being. It means that is less sensitive to input errors through its intuitive capability.

The conception of a learning capable Neuro-Fuzzy inventory controller was being laid down and the operation was being proofed. A basic version was built and it was proofed that artificial intelligence methods including ANFIS is capable to complete the defined tasks. Future development is planned in this area with extended parameters and capabilities.

Referencies

[1] Dr. Bóna Krisztián: Készletezési folyamatos és rendszerek, készletezés-elmélet (2005, egyetemi jegyzet)